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The Classic

The Operative Treatment of Fractures*

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Abstract This Classic article is a reprint of the original work by William Arbuthnot Lane, The Operative Treatment of Fractures. An accompanying biographical sketch on William Arbuthnot Lane, M.S., F.R.C.S., is available at DOI 10.1007/s11999-009-0861-3. The Classic Article is ©1909 by Wolters Kluwer Health-Lippincott Williams & Wilkins and is reprinted with permission from Lane WA. The operative treatment of fractures. *Ann Surg*. 1909;50:1106.

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I HOPE to put before you clearly and briefly my views of and experience in the treatment of simple fractures.

I was originally led to resort to operative procedures by finding, from the dissection of bodies whose bones had sustained fractures, that the fragments when displaced had hardly ever united in anything approaching accurate apposition, and that definite changes took place in those joints whose functions were affected by the alteration in the physiology of the skeleton resulting from such imperfect replacement of the broken fragments.

A careful inquiry into the results of the treatment of fractures by splints and manipulation confirmed the experiences of the dissecting room and showed that the consequent joint changes meant depreciation in physique and the wage-earning capacity of those who had to engage in laborious pursuits. These views met with violent opposition till the discovery of X-rays proved that the first contention was true, while the law courts are steadily impressing on the profession, in a costly manner, the disabilities which are associated with imperfect restoration in the form of broken bones.

In 1894 I read before the Clinical Society of London my first paper on the results of the treatment of simple fractures by operation, and I contrasted them with those obtained by other means. Since that time I have continued to operate on all simple fractures in which I was unable to bring the fragments into satisfactory opposition when the circumstances of the patient required it.

During the last seventeen years, I have operated upon a very large number of recent fractures at all ages, from early infancy to extreme old age, with the same uniform success. I have employed various methods at different times, endeavoring to devise means of fixation of the fragments in accurate apposition which shall be at the same time effectual and easy of application. I soon recognized that if the treatment by open operation was to become general it was necessary that the procedure should be rendered as uncomplicated as possible.

The difficulty that has beset this treatment is that, if a foreign body is left in a wound the surgeon must be infinitely more careful about asepsis than he is in the ordinary course of events and careful in a degree proportionate to the bulk of the foreign body. Judging from what I have read on the subject, it would also appear that the methods of the antiseptic surgeon, as contrasted with those of the surgeon who practices asepsis, are prejudicial to success. It is

because of insufficient aseptic precautions and to some extent from a want of familiarity with the use of wire, screws, etc., that we hear so many complaints of the development of rarifying osteitis about a screw or wire perforating a bone, of screws working loose and consequently becoming ineffective for the purpose for which they were employed, and of the employment of such futile methods as ivory pegs, etc.

With the exercise of greater cleanliness and with an increasing manual dexterity these troubles will cease to arise. Why a surgeon should not be governed by the same principles by which an ordinary skilled mechanic works I cannot understand, but I presume that the surgeon has rarely had any such training as would fit him for this kind of work. Curiously enough, the opposition to such operative procedures which continued with such intensity for so long, seems to have suddenly diminished because several surgeons have broken loose from tradition and have satisfied themselves that by operation alone can the greatest measures of success be obtained.

I do not propose to discuss the various methods I have adopted for retaining the fragments immovably in accurate apposition, but will confine myself to describing those which I now find most effective for the purpose.

The locality of the incision should be carefully chosen, to avoid damage to important structures and especially to nerves, and to reduce to a minimum the chance of subsequent infection of the wound. In the lower extremity there is no risk to important vessels, tendons or nerves, but in the arm the conditions are very different, and every precaution must be taken.

To ensure asepsis, which one can do with certainty, an incision of ample length is made. Several folds of gauze are attached to the edges of the skin incision by means of fenestrated forceps specially constructed for the purpose. They are long and heavy enough to fall away from the wound and do not require to be held.

The forceps used to control hemorrhage exert pressure upon the bleeding vessels sufficient to permanently obliterate their lumen. By their use the necessity of the introduction of the gloved hand into the wound for the purpose of tying a ligature is avoided. The danger of the rubber glove is the possible presence of a puncture through which infection might enter the wound. The hæmostatic forceps are very long, so that the handles fall free of the wound.

All instruments employed for manipulating fragments, holding swabs, plates and screws, for drilling bones and driving in screws are also very long and very powerful, in order to avoid any contact with the wound of the portion of the instrument grasped by the hand, since the gloves are liable to be damaged in the powerful manual efforts which are sometimes necessary to restore the broken bone to its original form.

In considering the means by which accurate apposition of fragments are effected, we must take into account the nature of the fracture and whether one or two bones are involved. Besides this, comminution often adds greatly to the difficulty of the operation.

In torsion fractures the surgeon must remember that in proportion to the overlapping of the fragments so there exists between and separating the surfaces which have to be brought into apposition an increasing quantity of muscle, since the chisel-shaped fragments diverge from one another as they overlap, burying themselves in the surrounding soft parts.

Any one who is imbued with the old creed and unfamiliar with operations on recent fractures, would imagine that to effect apposition all that is necessary is to exert traction upon the distal fragment of the broken bone by pulling on the limb, the trunk being secured, and that by means of this traction the fragments can be drawn from their beds in the soft parts and the fractured surfaces placed in accurate contact.

In the case of spiral fractures of the long bones of the lower extremity, in which this variety of fractures is the most common, no amount of traction which can be exerted on the limb is sufficient to overcome the over-riding of the fragments. This is due to the resistance offered by the bruised and swollen soft parts which surround the fractured bone and from the point of view of traction on the limb form inextensible ties in its length. This applies equally to fractures produced by direct injury, the resistance to replacement varying with the extent of overlapping of the fragments, the amount of extravasation of blood, the laceration of soft parts and the consequent inflammation.

To effect apposition in spiral fractures it is necessary to divide of displace all soft parts intervening between the fragments, to carefully clean away any clot or soft tissues from the fractured surfaces and especially from the retreating angles of the fragments, and to exert traction on the limb, supplementing that traction by forcible apposition of the fragments by powerful forceps, which are so manipulated as to glide the inclined plane of one fragment upon the other. This gliding of the fragments is facilitated by the introduction of a narrow flat blade with a serrated edge to prevent it slipping between the fragments. This, when rotated upon its axis, by its powerful leverage action moves the fragments held together by the forceps upon one another.

In the case of a fracture of a single bone, as the femur, which has been broken by direct injury, the extent of the overlapping of the fragments is from the nature of the injury and the mode of causation of the fracture usually much less. Still, the damage sustained by the surrounding soft parts or ties in the length is correspondingly greater, since in the torsion fracture the injury which the muscles

sustain results solely from the fracture, while in that produced by direct injury the soft parts are lacerated and bruised by the impact of the force which determined the fracture, and only to a small extent from the forcible displacement and overlapping of the fragments.

In a fracture of the femur produced by direct injury, traction alone exerted on the limb does not appear to influence the over-riding of the fragments. The fragments can most readily be brought into apposition by so manipulating the limb that the extremities of both are made to protrude through the incision and can be manipulated till the inner margins of the fractured surfaces are brought in contact with one another. Each fragment is grasped with forceps, and while the limb is slowly and steadily extended the opposing edges of the ends of the fragments are levered on one another till the broken surfaces come into accurate apposition, when the axes of the fragments are in continuity and the bone is restored to its normal form.

This difficulty does not exist to the same extent in fractures of the upper extremity produced by direct injury, since the ties in this limb are less bulky and tense than in the leg, and, from the nature of things, spiral or torsion fractures are of comparatively rare occurrence in the humerus, radius or ulna, though they are not infrequent in the metacarpals.

The difficulty of effecting accurate apposition is very greatly increased by the presence of comminution, which can make a considerable demand on the skill and ingenuity of the surgeon. This complication produces most obstacles in the case of the spiral fractures, since every aspect of the fragments is very oblique and much is necessarily out of sight and there is no surface or point on which one fragment may be made to pivot or impact on the other.

Perhaps the most awkward complication one may have to meet is great fragility of the fragments, such as appears to exist to a great extent in alcoholics and to a lesser degree in feeble children and in old age. But this concerns the retention of the fragments in apposition rather than their reduction.

Delay in operating renders the replacement of the fragments more difficult because the shortened soft parts or ties become rapidly less extensible and a correspondingly greater force is required to stretch them. This is a serious matter if the bones are fragile or comminuted. The operation should be undertaken as soon as the skin can be effectually cleansed.

As to the best means of retaining fragments securely in apposition when the fractured bone has been restored to its normal form, I would point out that in certain fractures, as in those about epiphyseal lines, there is usually no tendency to a recurrence of the displacement once reduction has been effected, providing the part is put up in a position the reverse of that in which it was produced. For instance, in a Colles' fracture either through bone or through the junction of the shaft with the epiphyseal line, after replacement of the fragment by manipulation or operation the hand is retained in a position of extreme flexion and adduction, which is also the extreme position of usefulness. It is well to remember that if the surgeon has to employ any means for retaining an epiphysis in position, as, for example, in separation of the lower epiphysis of the femur, he should insist on the removal of the rigid connecting medium after union has been effected, otherwise it will control the growth in the epiphysial line and deformity will result. In a case of a complicated fracture through the inner half of the epiphyseal line of the lower end of the femur, objection was made to the removal of the staples which were employed to retain the fragment in position, because of the condition of the patient. Later this patient developed a bowed leg.

There are occasions on which it is necessary to rely on screws alone, as in the case of fractures of the neck of the femur and in some spiral fractures, but in the vast majority of cases I prefer to use as long and as strong a steel plate as possible, carrying as many screws as space permits. To reduce the difficulty of finding the drill hole in the distal compact layer of bone, which is frequently of no avail when the fragment is comminuted, I employ screws of a length only sufficient to engage the proximal compact tissue and threaded up to the head in order to secure as firm a hold as possible on the bone. For this purpose I use screws in two lengths— ½ and ⅝ inch, and in two gauges, Nos. 5 and 7. In the young infant I employ ⅜ and ½ inch screws in No. 3 gauge.

The fewer the varieties of screws employed the smaller is the number of drills and consequently the less complicated the operation, since each gauge of these modified screws requires only one drill. By this means I have reduced enormously the difficulties of securing the fragments immovably in apposition. In simple fractures I hardly ever use wire. I would exclude from this the fractures of infancy when two or more weeks have been allowed to elapse between the receipt of the injury and the operation. In such cases the distal fragment loses its density at a very early period, and while the proximal fragment will hold the screw securely, the thread will get no secure grip of the distal portion because of its friability. In these circumstances I supplement the junction by encircling the plate and distal fragment with a loop of silver wire.

The operative measures which are required in the treatment of badly united fractures are similar except that the fragments have to be cut through in two distinct planes in fracture of a single bone and in four planes in fracture of two bones such as the radius and ulna or tibia and fibula, in order that the axes of the fragments can be rendered continuous. These operations are very much more difficult and are accompanied with more risk from hemorrhage than are

recent fractures. The results obtained are also very rarely as good, because of the changes which develop in the joints whose functions have been affected by the faulty junction. I think that with better initial treatment such cases will soon cease to exist.

Whatever the extent of the shortening in badly united fractures, the surgeon should endeavor to correct it entirely or to reduce it as much as possible. There is, as far as I am aware, no limit to which the muscles, nerves, vessels, etc., can be stretched if only sufficient force can be exerted on the fragments. Such operations may make a very great demand on the skill and resources of the surgeon, and an increasing familiarity with them will enable him to obtain an increased measure of success.